Las Vegas Wash Selenium Concerns

Selenium Sub-Committee
Doug Merkler, USDA - NRCS
May 24, 2006

Summary of selenium data collected to date.

Selenium concerns.

Recommendations/ Future monitoring needs.

Evaluation of Options.

Why is Selenium Important?

- Water Quality Standards – chronic 96 hr, 5 μg/L (ppb).
- Aquatic life. dry weight in whole body fish tissue, (draft) 7.91 mg/kg (ppm).
- Bird eggs toxicity threshold, dry weight 8 mg/kg (ppm).

Background 2000 to 2005

- Validated historical data – pre 2000:

"Literature Search and Database Development of Selenium Data Within the Las Vegas, Nevada Vicinity"

- Water
- Sediment
- Tissue – plant and animal

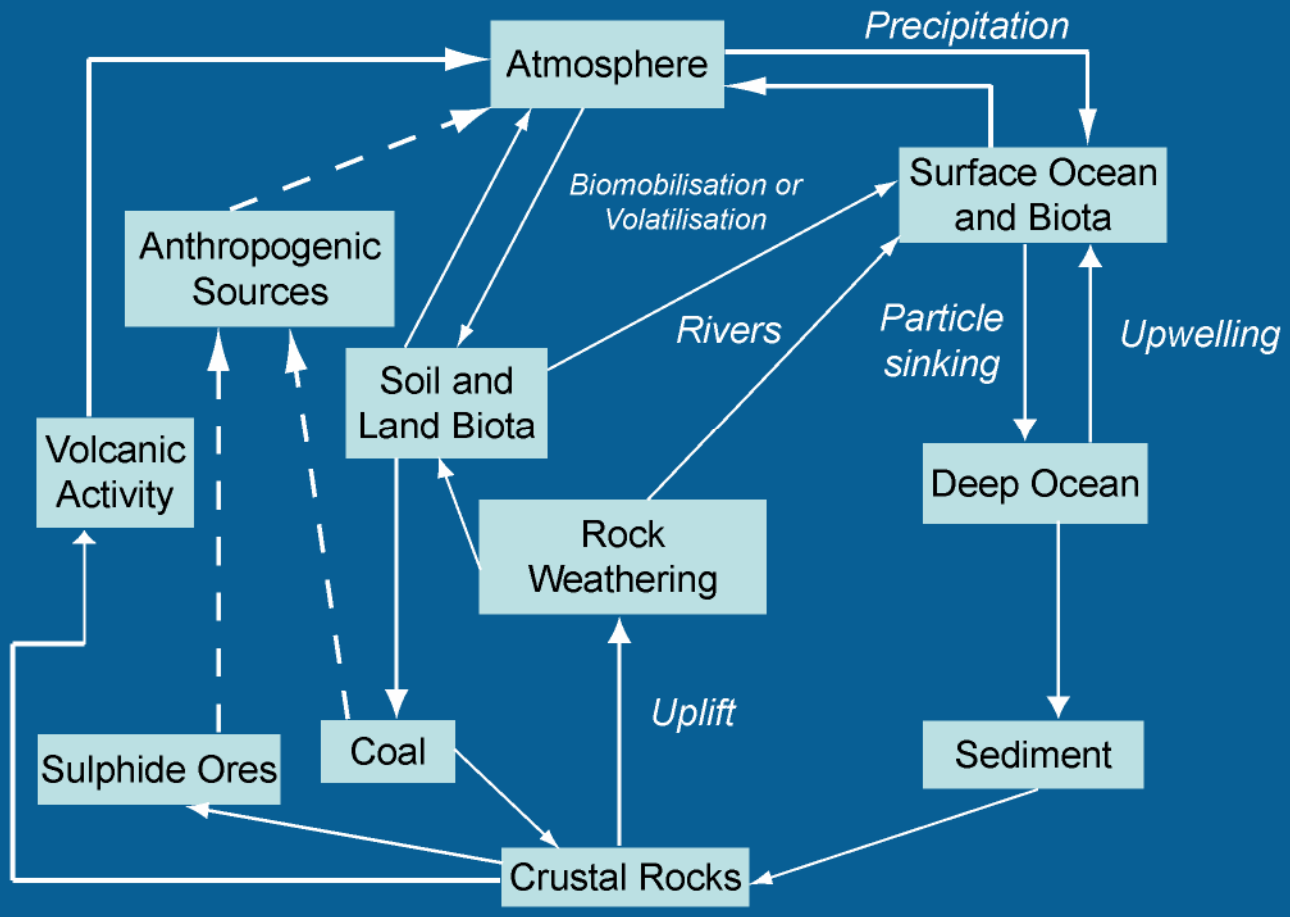




"… selenium appears to demonstrate the strongest evidence of potential risk based on the information gathered in this analysis."

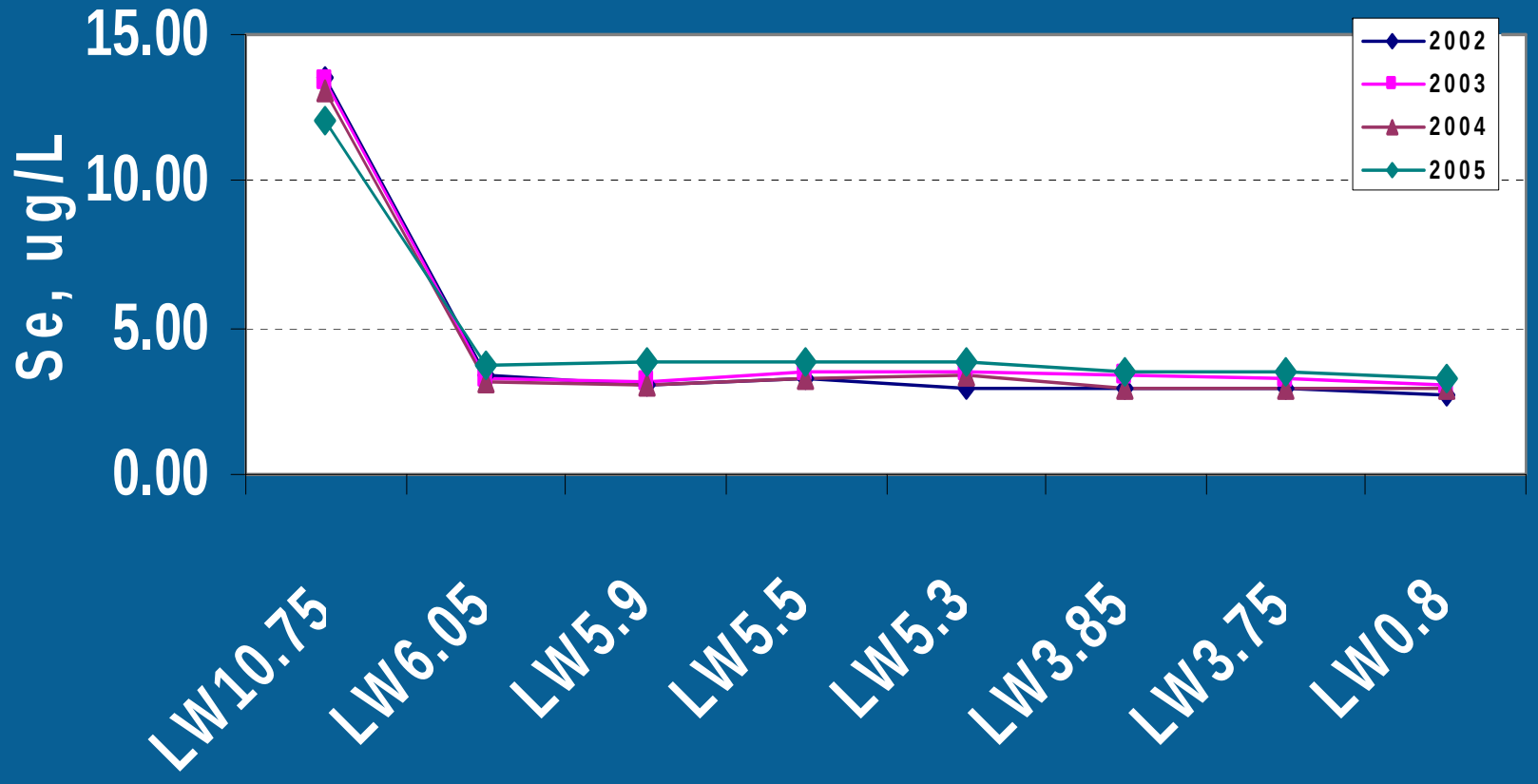
Draft Report, April 17th, 2006:
Las Vegas Wash Monitoring and Characterization Study
Erin Snyder Ph.D. Senior Toxicologist

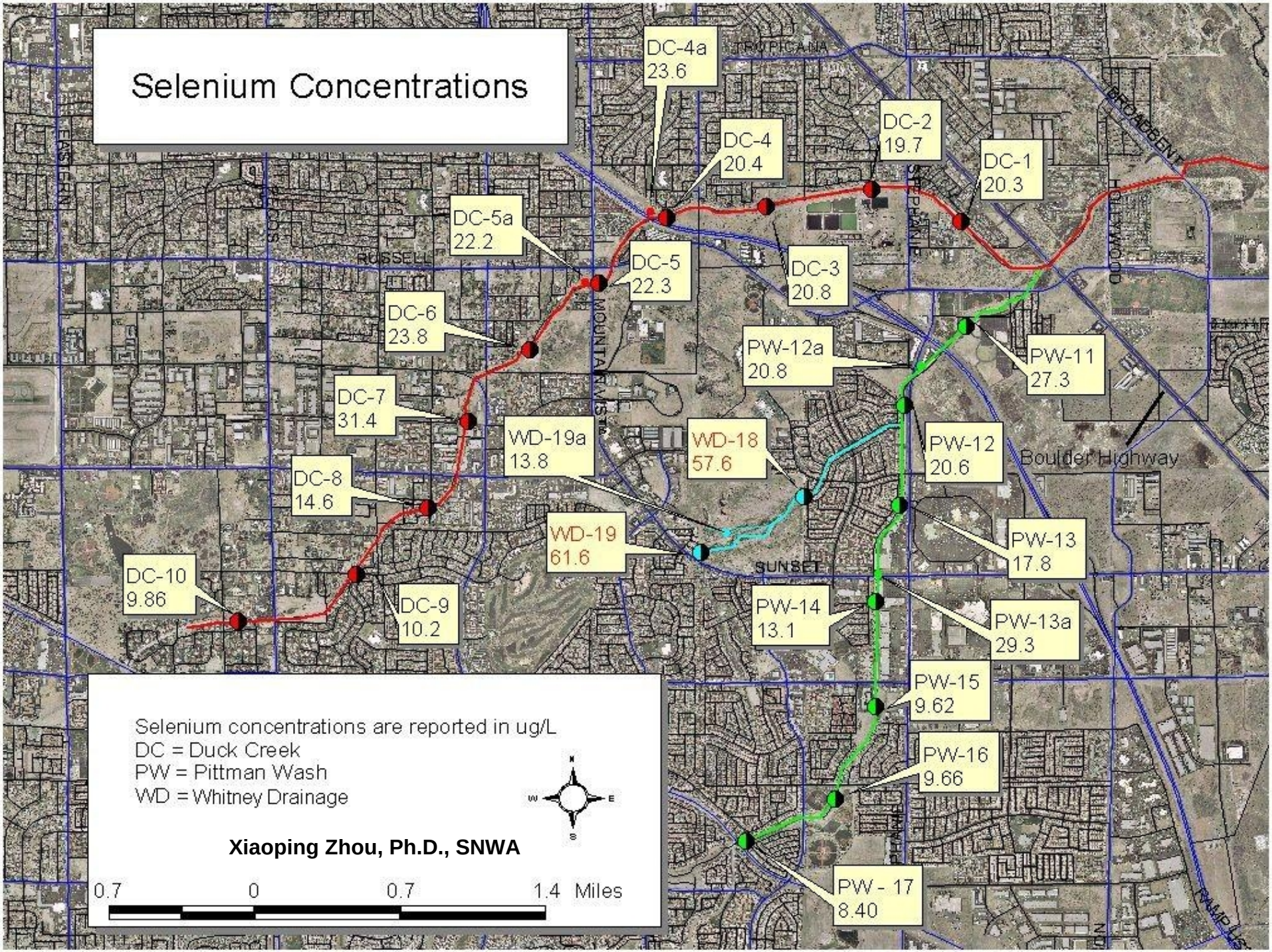
Selenium cycle



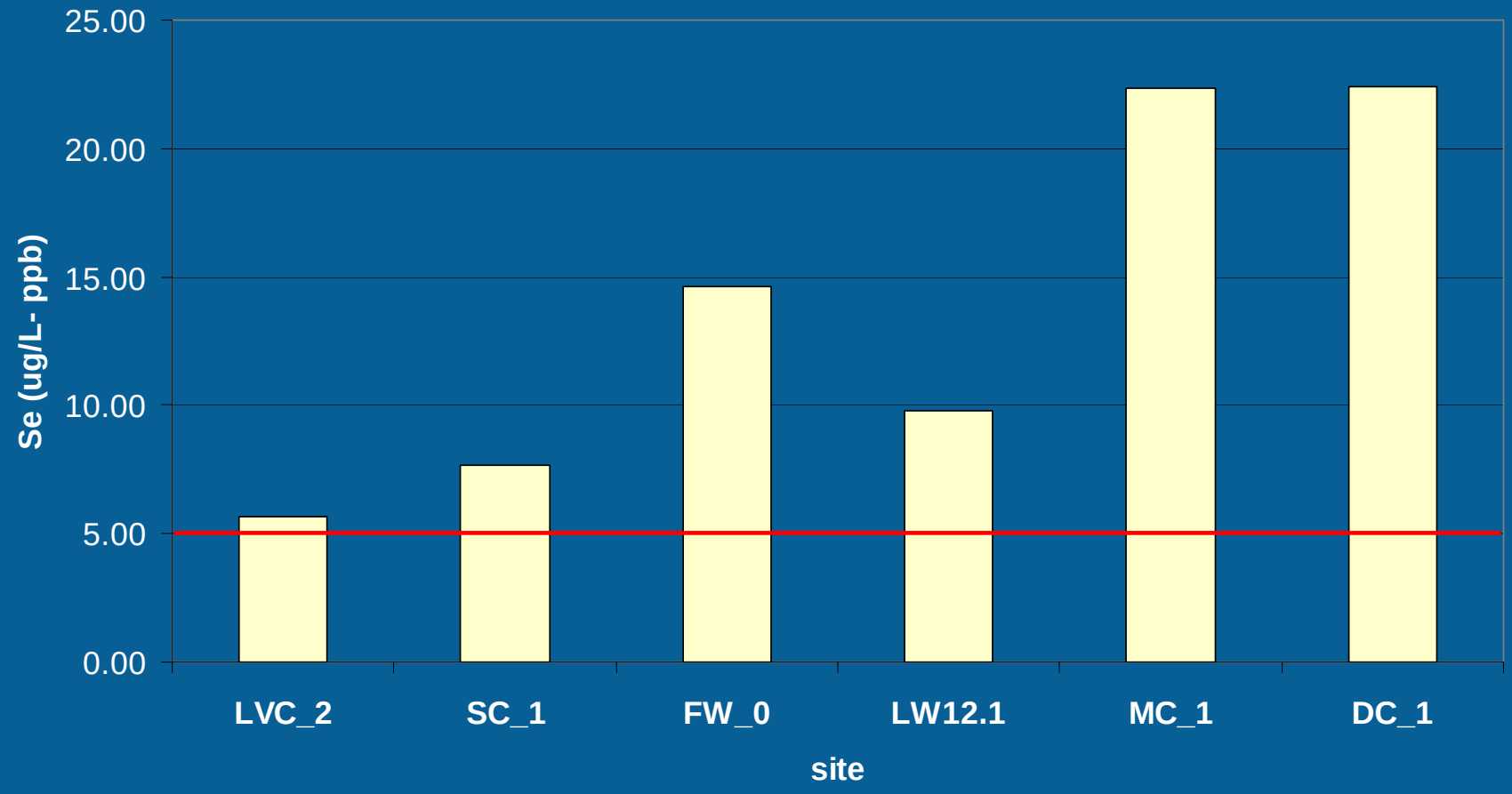
Allaway, 1968

Selenium Concentrations in Mainstream Las Vegas Wash



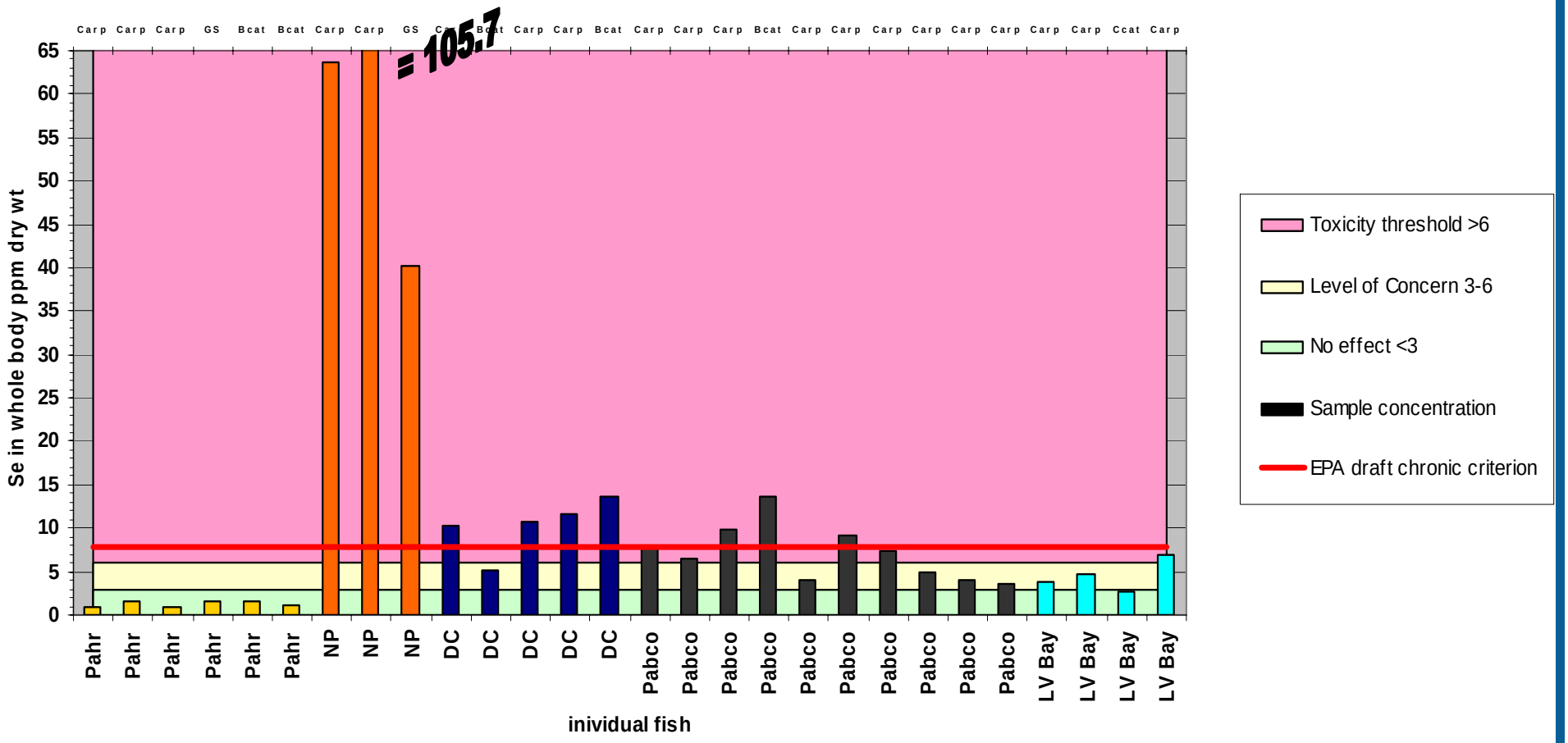

Selenium Concentrations
DC-4a
23.6
DC-4
20.4
DC-2
19.7
DC-1
20.3
DC-5a
22.2
DC-5
22.3
DC-3
20.8
DC-6
23.8
PW-12a
20.8
PW-11
27.3
DC-7
31.4
WD-19a
13.8
WD-18
57.6
PW-12
20.6
DC-8
14.6
WD-19
61.6
PW-13
17.8
DC-10
9.86
DC-9
10.2
PW-14
13.1
PW-13a
29.3
PW-15
9.62
PW-16
9.66
PW - 17
8.40
TROPICANA
BROADBENT
RUSSELL
MOUNTAIN VISTA
SUNSET
Boulder Highway
Selenium concentrations are reported in ug/L
DC = Duck Creek
PW = Pittman Wash
WD = Whitney Drainage
Xiaoping Zhou, Ph.D., SNWA
0.7
0
0.7
1.4 Miles

Selenium Concentrations in Tributaries to Las Vegas Wash

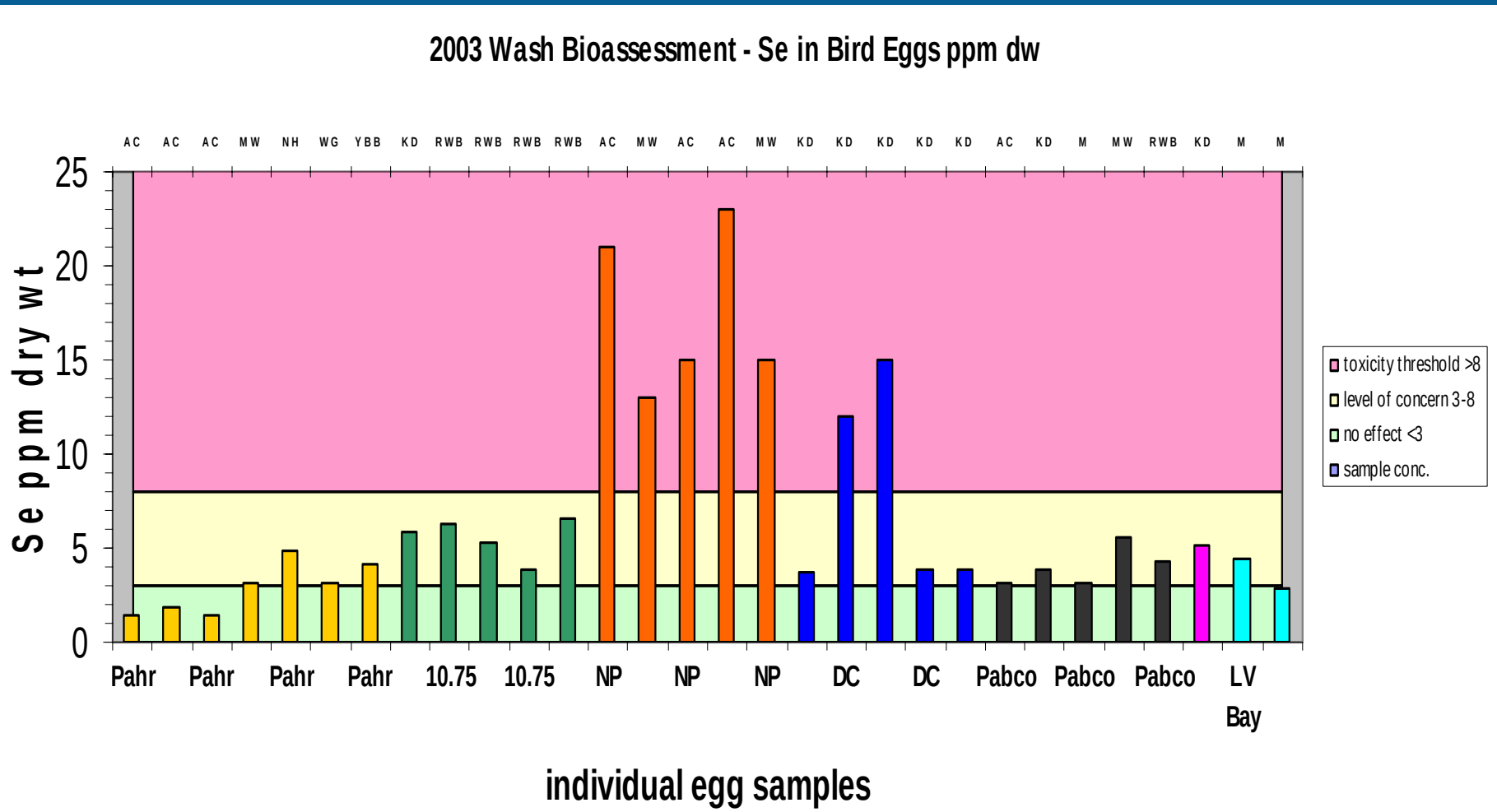


Fish Tissue - 2003
whole body

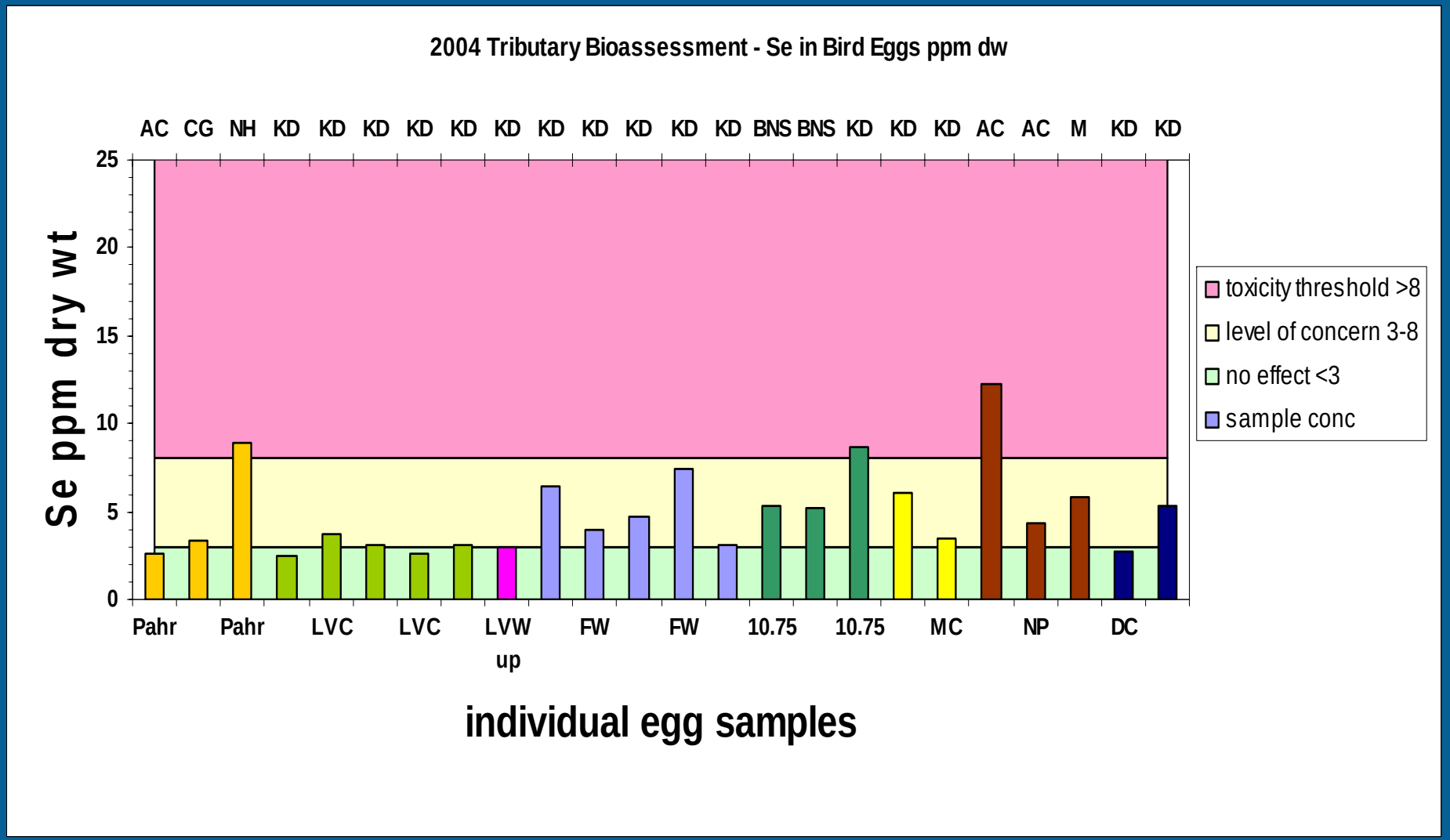
2003 Wash Bioassessment - Selenium in Fish ppm dw



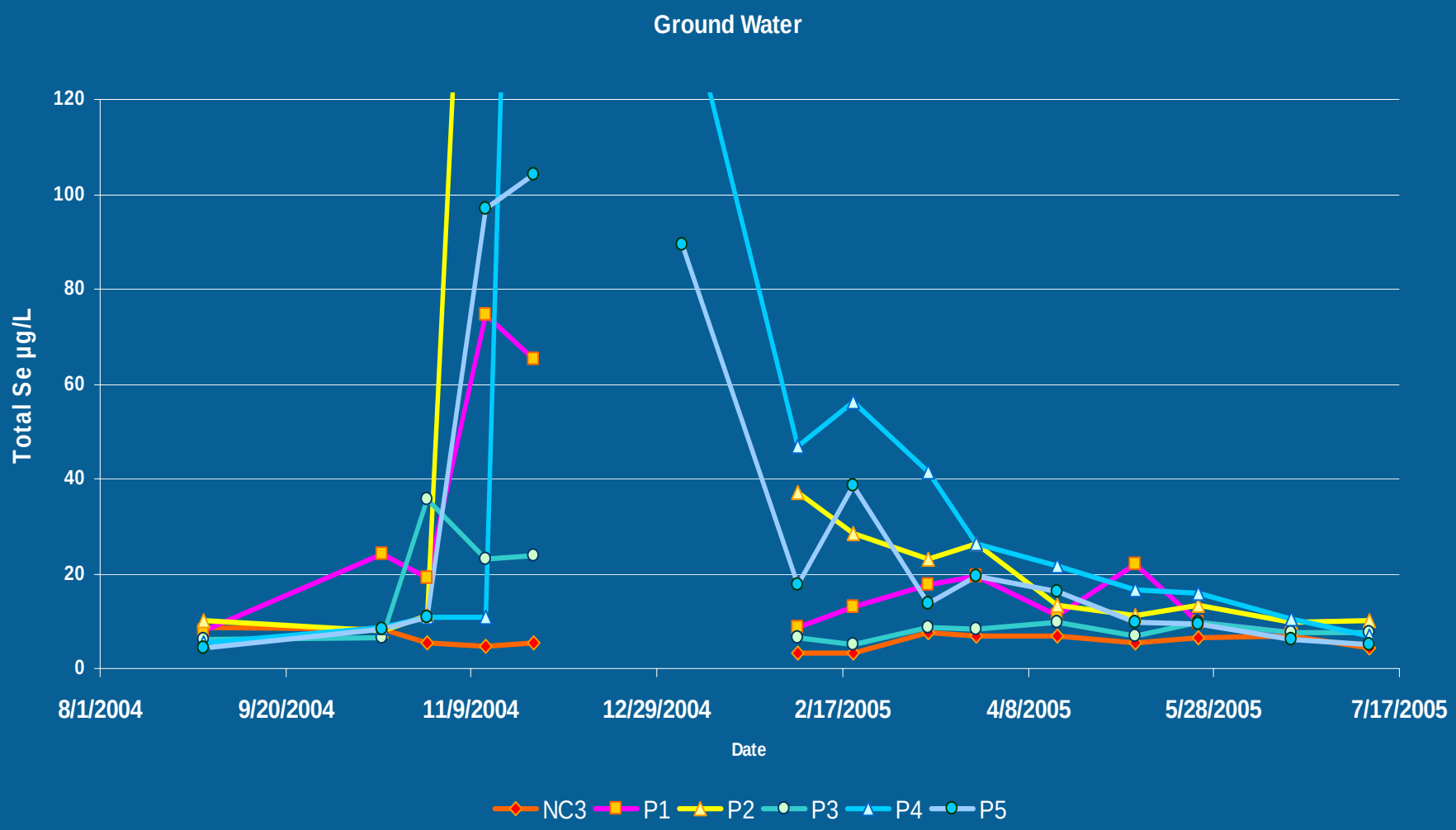
Bird Eggs - 2003



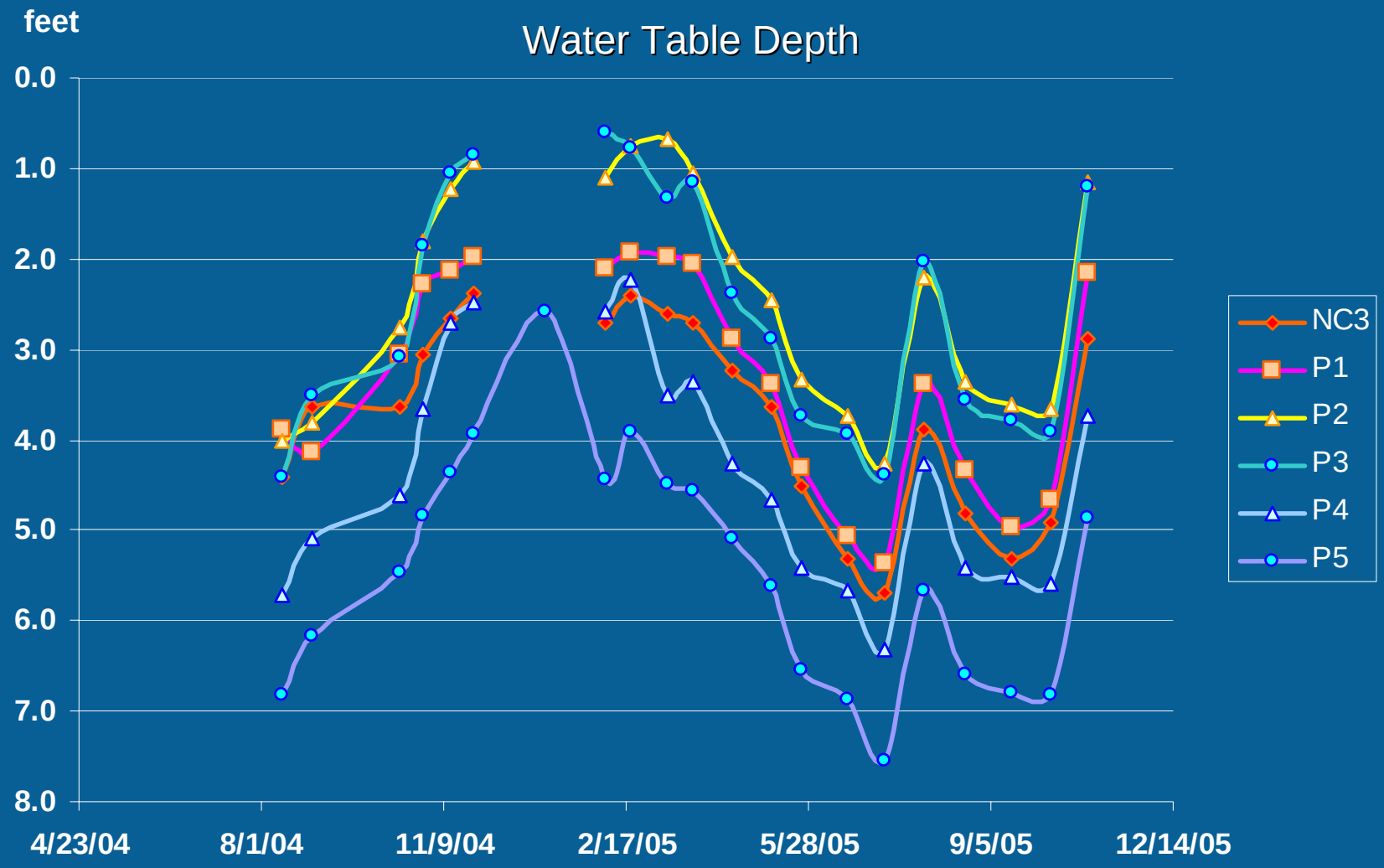
Bird Eggs - 2004



Selenium Concentrations in Groundwater
Nature Preserve - UNR



Groundwater Depth
Nature Preserve - UNR

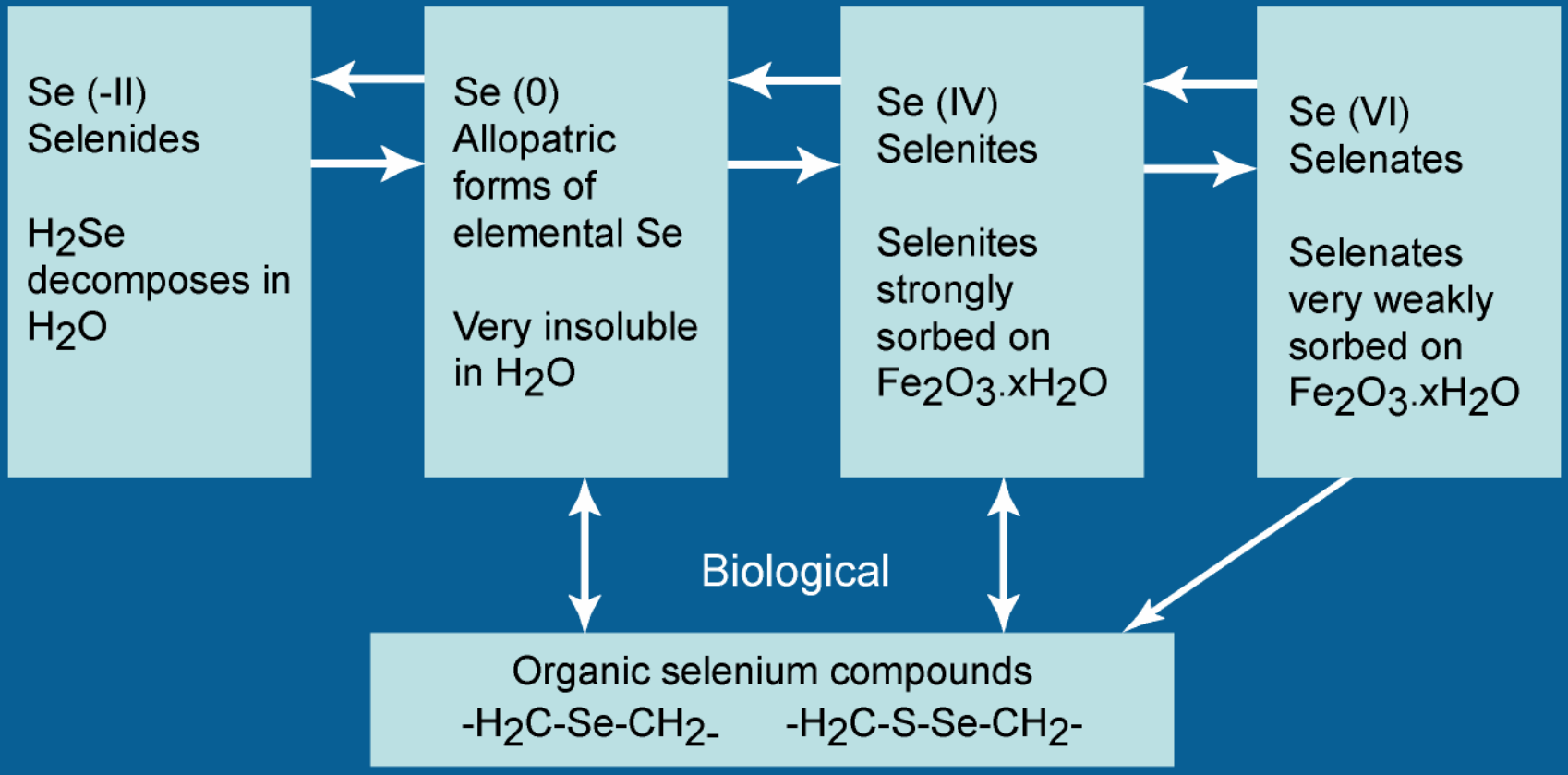


Selenium vs. Sulphur

Selenium, because of its similar size and electronegativity to sulphur, can substitute for sulphur in both organic and inorganic compounds.

The large range of oxidation states allows both elements to participate in extensive oxidation or reduction reactions, making them ideal for biologically active systems.

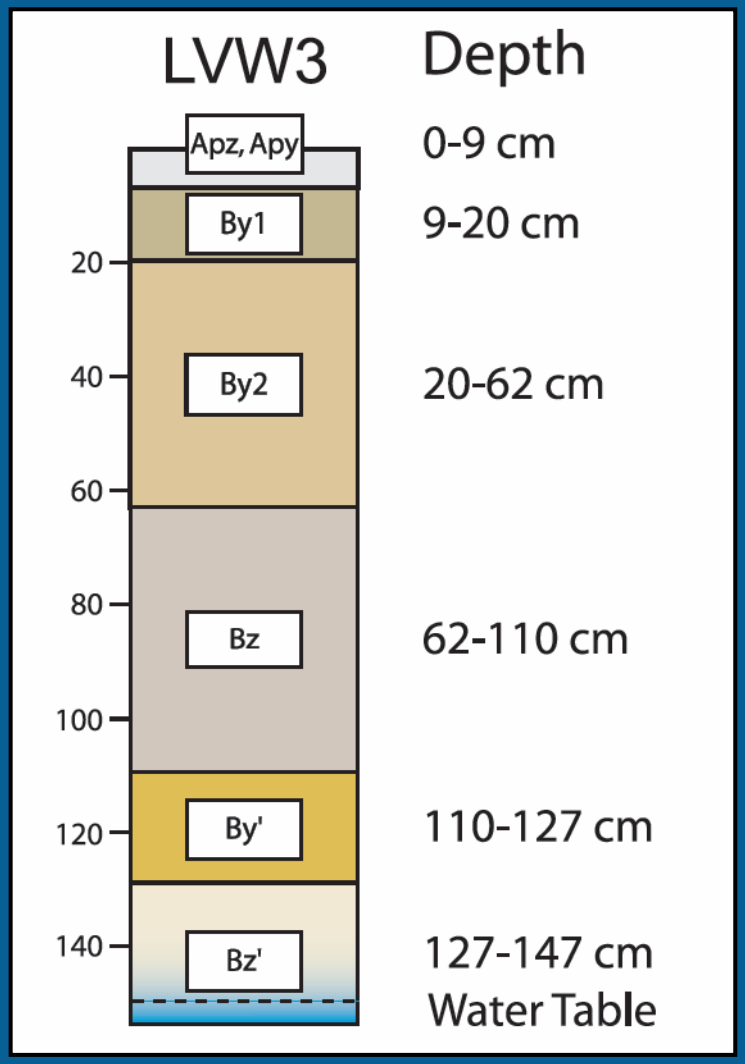
Selenium oxidation states



modified from MacGregor et al., 1998

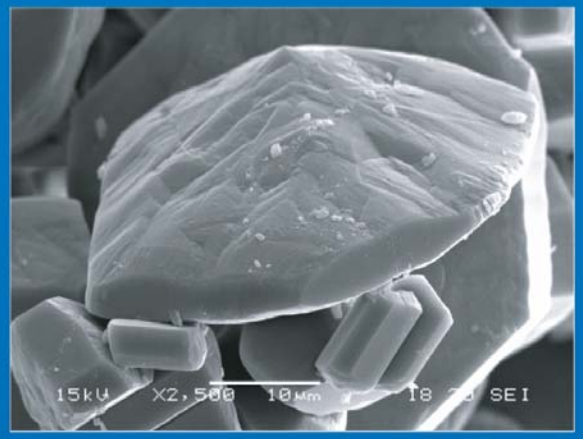
Sediment – UNLV / DRI

Duck Creek



Buck et al., 2006, *in press* SSSAJ

Halite NaCl



Gypsum $CaSO_4 \cdot 2H_2O$

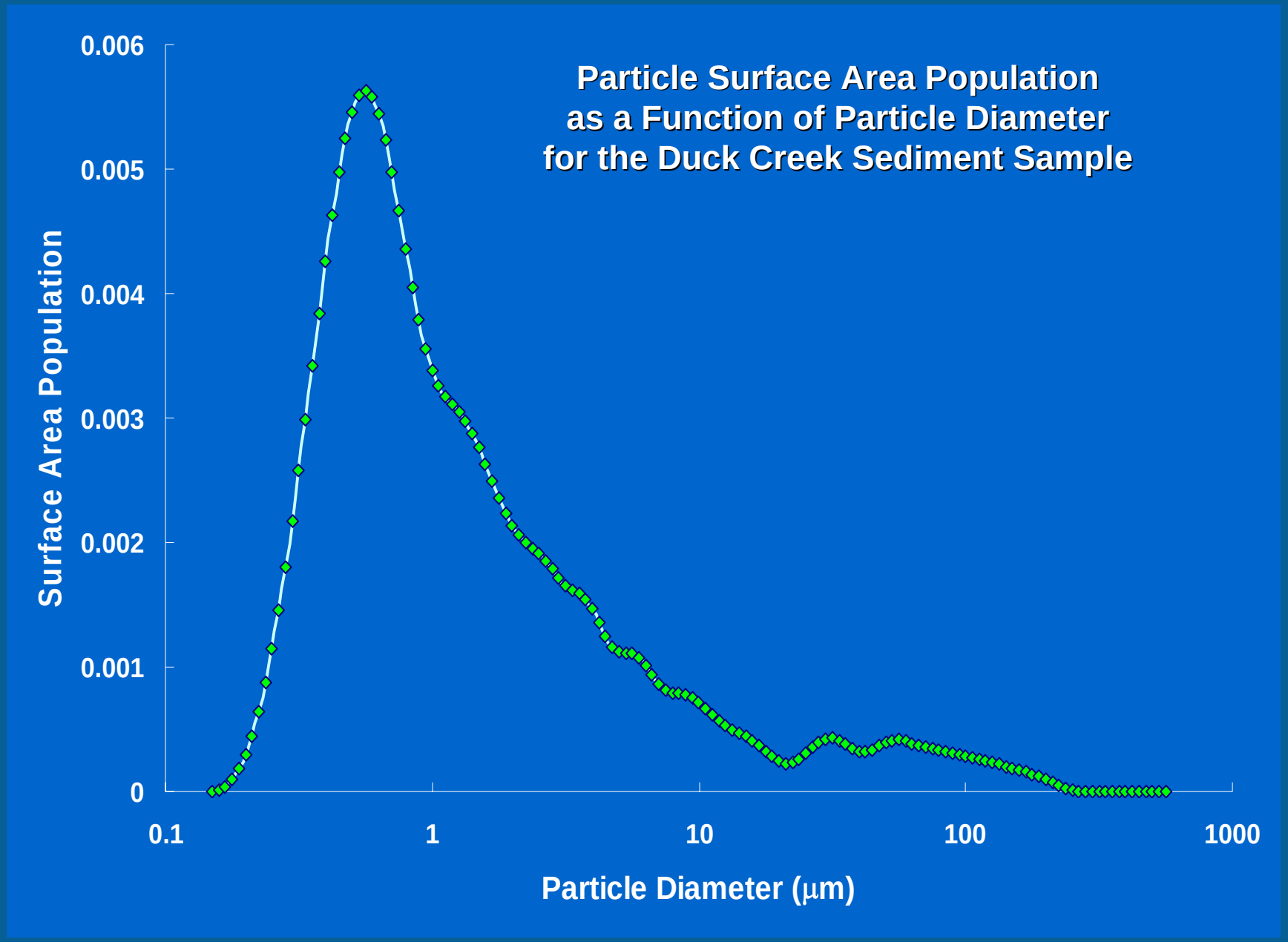
Sediment – UNLV / DRI

"…distinctive zones of subsurface accumulations of soluble salts that we attribute to evaporation from relict water tables.

The lowered water tables are the result of erosional entrenchment of the axial stream channel caused by increased urbanization and runoff.

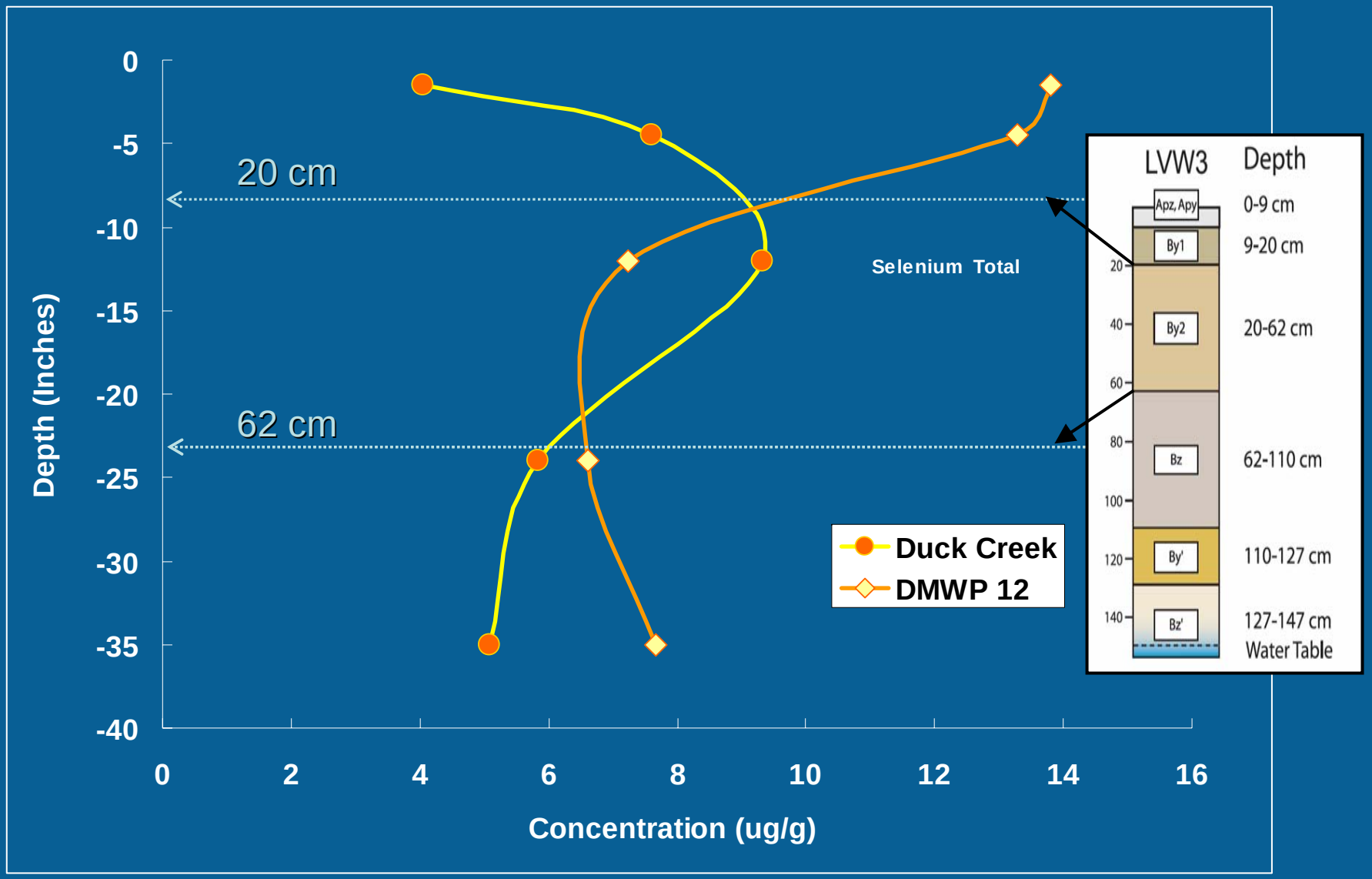
This disconnection of the water table from the surface has helped formed areas of soluble salt accumulation lower in the profile which may be important as a proxy for zones of selenium concentration."

Buck et al., 2006, *in press* SSSAJ



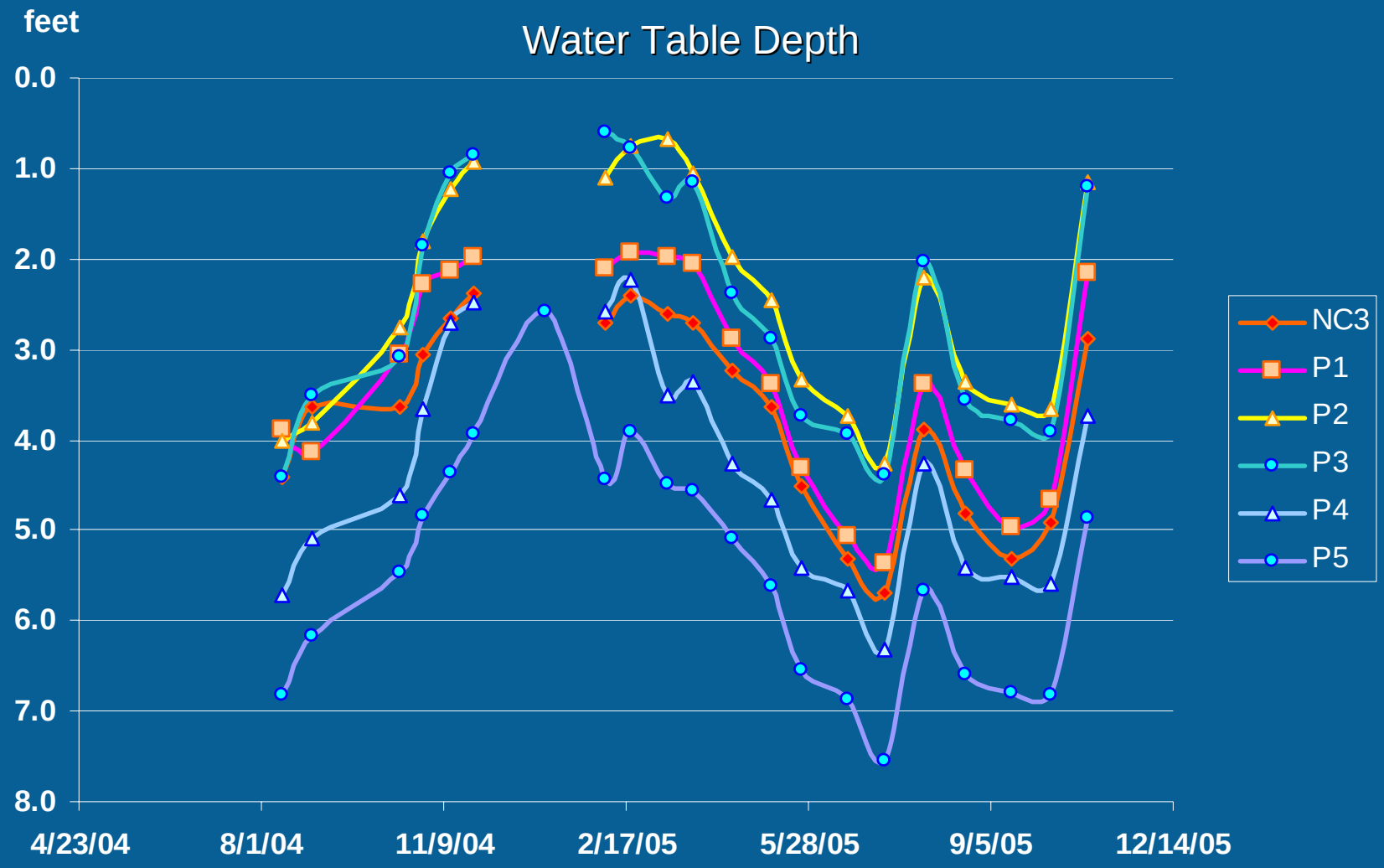
Papelis, DRI, unpublished data

Se concentration with depth



Papelis, DRI, unpublished data

Groundwater Depth
Nature Preserve - UNR



Selenium Concerns

- Aquatic life beneficial use standard for selenium in water is 5 µg/L, (ppb).
- Current selenium concentration in Las Vegas Wash is 4 µg/L (ppb).
- Five of five tributaries exceed the water quality standard for selenium.

Selenium Concerns, continued

- Wash is currently meeting or exceeding thresholds of concern for selenium for wildlife health. If concentrations increase it will only exacerbate the problem.

- Preliminary mass balance *(no loss by evaporation or sedimentation)* shows concentration of selenium in Las Vegas Wash will be 6.5 µg/L or higher with 30 MGD (millions of gallons / day) wastewater flow.

Selenium Concerns, continued

- Shallow groundwater has the potential to release higher concentrations of selenium to the Wash (flooding, de-watering of housing projects).
- Changing flows in the Wash has the potential to mobilize selenium (flux in groundwater depth).
- Development of land in areas with high selenium may create an attractive nuisance.

Recommendations/Future Needs

Selenium Sub-Committee suggests the LMWQF recommend to the LVWCC:

- Measure Nesting Success.
- Refine Bioassessment in 2007 and 2009.
- Target those areas and contaminants that are of most concern.
- Identify additional selenium source areas.
- Shallow groundwater monitoring of the floodplain.

Evaluation of Options

LMWQF recommends the LVWCC evaluate alternatives to reduce selenium concentrations in the tributaries to the Wash and in the Wash.

Treatment or Dilution?


Questions?